

REMARKS

Summary of Office Action

As an initial matter, Applicants note with appreciation that the Examiner has acknowledged the claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f) and the receipt of a certified copy of the priority document.

Claims 11-27 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by SCHMIDT et al., U.S. Patent No. 6,287,639 (hereafter “SCHMIDT I”) as evidenced by MDDS data sheet of Sigma-Aldrich.

Claims 11, 17 and 18 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by SCHMIDT et al., U.S. Patent No. 6,378,599 (hereafter “SCHMIDT II”) as evidenced by MDDS data sheet of Sigma-Aldrich.

Claims 28, 29 and 30 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Espin et al., U.S. Patent No. 6,513,592 (hereafter “ESPIN”) in view of SCHMIDT I as evidenced by MDDS data sheet of Sigma-Aldrich.

Response to Office Action

Reconsideration and withdrawal of the rejections made in the present Office Action are respectfully requested, in view of the following remarks.

Response to Rejections under 35 U.S.C. § 102(b)

Claims 11-27 are rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by SCHMIDT I as evidenced by MDDS data sheet of Sigma-Aldrich and claims 11, 17 and 18 are additionally rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by SCHMIDT II as

evidenced by MDDS data sheet of Sigma-Aldrich. The rejections essentially allege that SCHMIDT I and SCHMIDT II disclose all of the elements which are recited in the rejected claims. In particular, the Examiner appears to take the position that even the particle-free consolidating agent recited in amended independent claim 11 submitted in response to the previous Office Action is anticipated by SCHMIDT I and SCHMIDT II because the “consolidating agents” described therein allegedly are particle-free as well.

Applicants respectfully traverse these rejections for all of the reasons which have been set forth in the response to the previous Office Action. The corresponding remarks are incorporated herein.

Further, particularly from the Examiner’s comments in pages 2 and 3 of the present Office Action it appears that the present rejections are based on the Examiner’s incorrect interpretation of the description of the “consolidating agents” in SCHMIDT I and SCHMIDT II.

Accordingly, in the following the relevant disclosures of SCHMIDT I and SCHMIDT II will be discussed in detail to make it evident that the “consolidating agents” of SCHMIDT I and SCHMIDT II are not merely pure (liquid) silanes (or hydrolysates/precondensates thereof, respectively) but nanocomposites which necessarily contain (surface-modified) particles.

In particular, col. 1, lines 3-24 of SCHMIDT I specifically relied on by the Examiner states (emphasis added):

The invention relates to composite materials characterized by a substrate and by a nanocomposite which is in functional contact with the substrate and is obtainable by surface modification of

a) colloidal inorganic particles with

b) one or more silanes of the general formula (I)



where the radicals A are identical or different and are hydroxyl groups or groups which can be removed hydrolytically, except methoxy, the radicals R are identical or different and are groups which cannot be removed hydrolytically and x is 0, 1, 2 or 3, where $x \geq 1$ in at least 50 mol % of the silanes;

under the conditions of the sol-gel process with a sub-stoichiometric amount of water, based on the hydrolysable groups which are present, with formation of a nanocomposite sol, and further hydrolysis and condensation of the nanocomposite sol, if desired, before it is brought into contact with the substrate, followed by curing, said substrate not being a glass or mineral fibre or a vegetable material.

In other words, according to SCHMIDT I a substrate which may be considered to correspond to the “molded articles and geological formations comprising at least one of porous materials and particulate materials” recited in present claim 11 is contacted with a nanocomposite (sol) which may be considered to correspond to the consolidation agent for these “molded articles and geological formations” recited in present claim 11. This nanocomposite (sol) is prepared by combining, under conditions of the sol-gel process, colloidal inorganic particles with one or more silanes of the general formula (I) and water, resulting in a surface-modification of the colloidal inorganic particles with a hydrolysate/precondensate of the one or more silanes of the general formula (I). Consequently, the “consolidating agent” of SCHMIDT I (= the nanocomposite (sol)) necessarily contains particles, i.e., (surface-modified) colloidal inorganic particles.

The above process is illustrated by, for example, the procedure described in Example 6 of SCHMIDT I (one of the Examples of SCHMIDT I specifically relied on by the Examiner):

803 ml of MTEOS and 223 ml of TEOS are mixed and divided in a ratio of 1:1. Half of the silane mixture is intensively stirred with 165 g of ZrO₂ sol (NYS-30A from Nissan Chemicals) and 4.4 g of concentrated hydrochloric acid, and mixed, after 5 minutes, with the second half of the silane mixture.

After a post-reaction phase of 12 hours, the binder is intensively mixed with 10% by volume of water and stirred for a further 5 minutes. To the resultant mixture, boron nitride with a mean particle size of 1 µm is added in an amount such that 85% of the total material consists of boron nitride. The resultant material is spread onto a glass plate at a thickness of about 0.5 mm. After drying for 12 hours at room temperature, the layer is removed and sintered at 500° C. as a free-standing body, giving a solid shaped article.

Accordingly, Example 6 of SCHMIDT I describes the consolidation of a substrate, i.e., boron nitride powder (mean particle size 1 µm) with a binder (nanocomposite (sol)) according to the teaching of SCHMIDT I to form a solid shaped article made of bonded (consolidated) boron nitride powder. The binder is prepared by surface-modification of colloidal ZrO₂ particles with a hydrolysate/precondensate of a mixture of methyltriethoxysilane and tetraethoxysilane. Accordingly, it is apparent that the binder for the boron nitride powder contains particles, i.e., (surface-modified) ZrO₂ particles. The same conclusion can be drawn from the remaining Examples of SCHMIDT I, wherein in some cases SiO₂ particles (silica sol) are used instead of ZrO₂ particles for making the agent for the consolidation and/or coating of various substrates.

In this regard, it additionally is noted that SCHMIDT I in some instances refers to the consolidated article (substrate plus cured binder) as “composite”. It is pointed out that this term must not be confused with the “nanocomposite” described by SCHMIDT I, which latter term denotes the surface-modified colloidal inorganic particles which serve as the binder for the substrate (and in combination with the substrate and after curing results in the production of a “composite”).

Regarding SCHMIDT II, it is noted that col. 1, lines 4-27 thereof states (emphasis added):

The invention relates to a foundry binder which is obtainable by surface modification of

- a) colloidal inorganic particles with
- b) one or more silanes of the general formula (I)



where the radicals A are identical or different and are hydroxyl groups or groups which can be removed hydrolytically, except methoxy, the radicals R are identical or different and are groups which cannot be removed hydrolytically and x is 0, 1, 2 or 3, where $x \geq 1$ in at least 50 mol % of the silanes;

under the conditions of the sol-gel process with a sub-stoichiometric amount of water, based on the hydrolysable groups which are present, with formation of a nanocomposite sol, and further hydrolysis and condensation of the nanocomposite sol, if desired, before it is brought into contact with the foundry sand.

The nanocomposite sol employed according to the invention is prepared by surface-modification of colloidal inorganic particles (a) with one or more silanes (b), if desired in the presence of other additives (c) under the conditions of the sol-gel process.

In other words, according to SCHMIDT II a nanocomposite sol (which may be considered to correspond to the “consolidation agent for molded articles and geological formations” recited in present claim 11) is used as a binder for foundry sand (which may be considered to be encompassed by the “molded articles and geological formations comprising at least one of porous materials and particulate materials” recited in present claim 11).

The nanocomposite sol is prepared by combining colloidal inorganic particles, one or more silanes of the general formula (I) and water under conditions of the sol-gel process, resulting in the surface-modification of the colloidal inorganic particles with a hydrolysate/precondensate of the one or more silanes of the general formula (I). Accordingly,

there can be no doubt that the binder of SCHMIDT II necessarily contains particles, i.e., (surface-modified) colloidal inorganic particles.

The above process is illustrated by, for example, the procedure described in Example 1 of SCHMIDT II (one of the Examples of SCHMIDT II specifically relied on by the Examiner):

51.3 ml of MTEOS (corresponding to 60 mol %), 19.1 ml of TEOS (corresponding to 20 mol %) and 15.0 ml of PTEOS (corresponding to 20 mol %) are mixed, and half of this mixture is vigorously stirred with 11.7 ml of silica sol (corresponding to a proportion of silica sol of 14.3% by weight) and 0.386 ml of concentrated hydrochloric acid. After 5 minutes, the second half of the alkoxide mixture is added to the charge and then stirring is continued for a further 5 minutes. The resultant sol is then subjected to a post-reaction step (standing at 60° C. for 12 hours).

About 2.5 ml of water are added to the sol before it is used, in order to reach a water content of 0.5 mol of water per mole of hydrolysable group. The resultant sol is mixed with an amount of sand of a particle size of about 1 mm, so that about 84% of the total weight consists of the sand. The material is tamped in a mould and hardened at 100° C. for 20 minutes, giving a mechanically robust shaped article which does not lose its shape even after exposure to a temperature of 500° C. for 1 hour.

Accordingly, Example 1 of SCHMIDT II describes the consolidation of (foundry) sand of a particle size of about 1 mm by means of a binder, i.e., a sol to form a mechanically robust shaped article. The sol is prepared by contacting colloidal inorganic (SiO₂) particles in the form of a silica sol with a mixture of three silanes and water under the conditions of the sol-gel process, resulting in the surface-modification of the inorganic particles with a hydrolysate/precondensate of the mixture of the three silanes employed. Again, there can be no doubt that the sol used as a binder for the sand necessarily contains particles, i.e., (surface-modified) SiO₂ particles.

The above comments should have made it entirely clear that the consolidation agent recited in claim 11 of record differs from the compositions (nanocomposite sols) taught by

SCHMIDT I and SCHMIDT II for at least the reason that it is particle-free. In view thereof, it is apparent that SCHMIDT I and SCHMIDT II are unable to anticipate the subject matter of any of the claims of record (and in fact, even teach away therefrom). Accordingly, withdrawal of the rejection of claims 1-27 under 35 U.S.C. § 102(b) over SCHMIDT I or SCHMIDT II is warranted and again respectfully requested.

Response to Rejection of Claims under 35 U.S.C. § 103(a)

Claims 28, 29 and 30 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over ESPIN in view of SCHMIDT I as evidenced by MDDS data sheet of Sigma-Aldrich. The rejection alleges that ESPIN teaches a process for consolidating sand formations comprising injecting a consolidation system into the formation and curing thereof and further teaches the consolidation system is a fluid suspension of nanoparticles as disclosed in PCT/EP97/06370, of which SCHMIDT I is the English equivalent. The rejection concedes that ESPIN does not teach the claimed consolidation agent but alleges that “[i]t would have been obvious to a person of ordinary skill in the art to inject the agent of claim 11 into the formation and curing thereof for the benefit of consolidating sand formations, because [ESPIN] specifically teaches the particles of [SCHMIDT I]”.

This rejection is respectfully traversed as well. In particular and as (implicitly) acknowledged by the Examiner, a critical feature of the method taught by ESPIN is the use of a composition which comprises nanoparticles. For example, the abstract of ESPIN states (emphasis added):

A method is disclosed for consolidating an unconsolidated formation, which method includes the steps of providing a well drilled to an unconsolidated formation, providing a consolidation fluid in the form of a fluid suspension of nanoparticles, and flowing said

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consolidation fluid through the well and into the unconsolidated formation so as to position the nanoparticles between grains of the unconsolidated formation whereby the formation is consolidated over time.

Further, in col. 2, lines 47-63 ESPIN explains the important function of nanoparticles for the method taught therein (emphasis added):

... Following injection of the displacement fluid, a consolidation system **16** is then injected. In accordance with the present invention, the consolidation system **16** is a fluid suspension of nanoparticles, preferably an aqueous suspension of nanoparticles as will be more thoroughly discussed below.

During this injection, nanoparticles lodge between loose grains of the unconsolidated formation. Consolidation occurs over time, and can be expedited as described below, wherein the nanoparticles form a bond of sufficient strength with adjacent contacting grains of sand that the Young's Modulus of the formation is substantially increased, for example to values of greater than or equal to about 1×10^6 psi. This is a substantial improvement as compared to untreated unconsolidated formations which can frequently have a Young's Modulus of less than or equal to about 0.4×10^6 psi.

Even further, in col. 3, lines 5-19, ESPIN states (emphasis added):

The nanoparticles of the present invention are provided having an average particle size of between about 1 nanometer (10^{-9} m) (nm) and about 200 nanometers (10^{-9} m) (nm). The nanoparticles are formed of molecules of organic and inorganic components. The inorganic component has an affinity for the sand grains of the formation. Thus, SiO_2 , for example, is suitable as the inorganic compound, particularly, silica and/or quartz. The organic component allows for polymerization bonding of the inorganic component to the contacting sand grains of the formation under certain pH conditions as explained hereinbelow. Suitable organic components include, for example, silanes, hydroxyls and/or alkaloids. Suitable nanoparticle materials for use in the method of the present invention include those disclosed in PCT/EP97/06370 published May 28, 1998.

The above statements in ESPIN make it abundantly clear that nanoparticles are a critical and indispensable feature of the method disclosed therein, wherefore ESPIN not only fails to render it obvious to one of ordinary skill in the art to employ the particle-free consolidation agent of the present invention for the purposes disclosed therein, but even teaches away therefrom.

Moreover, the passage in col. 3, lines 5-19 of ESPIN reproduced above is an independent confirmation that the "consolidating agent" of SCHMIDT I (i.e., the U.S. equivalent of PCT/EP97/06370 mentioned in this passage) does contain (nano)particles, contrary to what is alleged by the Examiner.

Applicants submit that for at least all of the foregoing reasons, ESPIN in view of SCHMIDT I as evidenced by MDDS data sheet of Sigma-Aldrich is unable to render obvious the subject matter of any of the present claims, wherefore withdrawal of the rejection of claims 28, 29 and 30 under 35 U.S.C. § 103(a) over these documents is warranted as well, and again respectfully requested.

CONCLUSION

In view of the foregoing, it is earnestly believed that all of the claims in this application are in condition for allowance, wherefore an early issuance of the Notices of Allowance and Allowability is respectfully solicited. If any issues yet remain which can be resolved by a telephone conference, the Examiner is respectfully invited to telephone the undersigned at the telephone number below.

Respectfully submitted,
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